ADOT ECS File: JPA 99-118
Project No. SPR-
TRACS No.: R0402 10P
Research: Develop Performance
Related AC Specifications

INTERAGENCY AGREEMENT
BETWEEN
THE DEPARTMENT OF TRANSPORTATION
AND
THE ARIZONA STATE UNIVERSITY

THIS AGREEMENT is entered into 3 AUGUST, 1999, between agencies of the State of Arizona, to wit; the DEPARTMENT OF TRANSPORTATION (the "DOT") and the ARIZONA BOARD OF REGENTS, acting for and on behalf of ARIZONA STATE UNIVERSITY, (the "University").

I. RECITALS

1. The DOT is empowered by Arizona Revised Statutes Section 28-401 to enter into this agreement and has by resolution, a copy of which is attached hereto and made a part hereof, resolved to enter into this agreement and has delegated to the undersigned the authority to execute this agreement on behalf of the DOT.

2. The University is empowered by Arizona Revised Statutes Section 15-1626 to enter into this agreement and has delegated to the undersigned authority to execute this agreement on behalf of the University.

3. The DOT and the University desire to conduct research and achieve the development and implementation of performance related AC specifications in several phases, all in accordance with Exhibit A which is attached hereto and made a part hereof, at an estimated total cost of $306,000.00, all at DOT expense, hereinafter referred to as the Project.

THEREFORE, in consideration of the mutual agreements expressed herein, it is agreed as follows:

II. SCOPE OF WORK

1. The DOT will:

a. Appoint a Project coordinator within the DOT's Transportation Technology Group to interface with the University relating to the research and development.

b. Provide the University with information and data as may be reasonably available to assist in the Project research and development.

c. Reimburse the University within forty-five (45) days after receipt and approval of monthly invoices, in a total amount currently estimated at $306,000.00.

2. The University will:

a. Appoint a Project coordinator at the University (ASU) to interface with the DOT relating to the research and development.

b. Accomplish the research and development generally in accordance with Exhibit A, which is attached hereto and made a part hereof, provide the DOT with appropriate progress reports, and a final report documenting the program, data derived, and the final results. Such reports will be in a format compliant with the DOTs "Guidelines for Preparing Research Reports."

c. No more often than monthly, invoice the DOT in the form of Exhibit B attached hereto, supported by narrative progress reports and an accounting of monthly costs and expenditures on the Project. Upon completion of the Project, provide the DOT with a detailed final report.

III. MISCELLANEOUS PROVISIONS

1. Title to all documents, reports and other deliverables prepared by the University in performance of this agreement shall rest jointly with the DOT and the University.

2. This agreement shall become effective upon signature by the parties hereto, and shall remain in force and effect until completion of said Project and reimbursements; provided, however, that this agreement, may be cancelled at any time prior to the commencement of performance under this agreement, upon thirty (30) days written notice to the other party.

3. The parties agree to comply with all applicable state and federal laws, rules, regulations and executive orders governing equal employment opportunity, immigration, nondiscrimination and affirmative action.

4. This agreement may be cancelled in accordance with Arizona Revised Statutes Section 38-511.

5. The provisions of Arizona Revised Statutes Section 35-214 are applicable to this contract.

6. In the event of any controversy which may arise out of this agreement, the parties hereto agree to abide by required arbitration as is set forth for public works contracts in Arizona Revised Statutes Section 12-1518.

7. All notices or demands upon any party to this agreement relating to the agreement shall be in writing and shall be delivered in person or sent by mail addressed as follows:

Department of Transportation	Arizona State University
Joint Project Administration	Research & Creative Act.
205 S. 17th Avenue - 616E	PO Box 871603
Phoenix, AZ 85007	Tempe, AZ 85287-1603

8. The parties recognize that performance by ASU under this Agreement may be dependent upon the appropriation of funds by the State Legislature of Arizona. Should the Legislature at any time fail to appropriate the necessary funds for such performance, the, by written notice to the DOT, ASU may cancel this Agreement.

IN WITNESS WHEREOF, the parties have executed this agreement the day and year first above written.

STATE OF ARIZONA

THE ARIZONA BOARD OF REGENTS
acting for and on behalf of
ARIZONA STATE UNIVERSITY

By Janice D. Bennett
JANICE D. BENNETT, Director
Office of Research and
Creative Activities
7-30-99

DEPARTMENT OF TRANSPORTATION

By E.H. Wright
~~TIM WOLFE~~ Dick Wright
~~Ass't State Engineer~~
Deputy Director

PROJECT DIRECTOR APPROVAL
I have reviewed the terms of this contract and they are acceptable to me. I request that an authorized signatory execute this contract on behalf of the university.

Matthew W. Witzke 29 July 99
Project Director: Date

99-118
15jul

Arizona State University

Research Proposal

"Development of Performance Related Specifications for Asphalt Pavements in the State of Arizona"

Submitted By

Dr. M. W. Witczak
Professor of Civil Engineering
Department of Civil and Environmental Engineering
Arizona State University
Tempe, Arizona 85287-5306

To

Arizona Department of Transportation
C/o Mr. Larry Scofield
1130 North 22nd Avenue
Phoenix, Arizona 85009

June 1999

Appendix A

ASU-ADOT Research Program
Project Descriptions

ASU-ADOT Research Projects
Brief Project Descriptions
Provisional Objectives Pending Detailed Development
Dr. M. W. Witczak
Version 1: June 1999

Project 1: Develop Long Range Pavement Research Plan for ASU-ADOT.
1 July 1999-30 September 1999 (3 months)
$25,000

The basic objective of Project 1 will be to develop a final detailed long range (5 year) research plan for establishing a research program between ASU and ADOT. This plan is intended to build upon and expand the level of detail provided in this initial preliminary plan framework. This study effort will result in a target deliverable planning report provided to ADOT that will finalize the proposed plan to include the detailed work tasks, a work performance schedule and a detailed budget breakdown of the anticipated project effort.

In order to accomplish this goal, a series of informational meetings with key ADOT personnel and the Principal Investigator will be scheduled so that the PI can be educated on a broad range of pavement related topics that will form the foundation details for many other projects that are proposed. For example, information concerning typical materials used in Arizona (AC Binders, Mixtures, Base/Subbase and Subgrades), Design and Performance problems, Major Distress Types, Arizona Specifications, Regional Climatic and Geomorphic Zones in the State and Design/Rehabilitation Methodologies will be discussed in order that the PI can develop a workable and highly realistic research plan that truly reflects the real needs of ADOT as perceived by key ADOT personnel.

It is desirable that the initial research planning report will be reviewed by ADOT and key comments presented back to the PI in order that a fully approved work plan is developed for the long range plan that integrates the views of key ADOT personnel. In this regard, it is also an allied goal of the project for the PI and key ASU staff to become as familiar as possible with all key ADOT engineering personnel and the organizational structure of ADOT.

Project 2: Develop Joint ASU-ADOT Superpave Lab Plan.
1 July 1999-31 December 1999 (6 months)
$15,000

The specific goal of this project will be to develop a plan report that details the requisite steps and activities that will need to be taken by ASU and ADOT to establish a joint Superpave Laboratory for asphalt and asphalt mixtures. This laboratory, when fully completed and equipped, should provide Arizona with full capabilities to perform

Superpave AC Binder tests, Superpave Gyratory Volumetric Designs and to be able to conduct advanced dynamic characterization tests on compacted mixtures that will be used in mechanistic pavement performance models that are being developed through the 2002 Design Guide project and the Superpave Models study

The plan will develop the specific details necessary to implement the testing program that will be a portion of several of the major projects delineated in this report and also presented in the final Project 1 scope of work The major issues to be addressed will be those associated with

a Develop a list of all needed testing equipment
b Identify key personnel positions that will be necessary to staff the Superpave lab
c Identify sources of future funding necessary to equip, staff and operate the facility in a continuous future manner
d Identify a truly workable plan to have a joint arrangement of ASU and ADOT personnel operate the facility
e Identify the optimum location for the facility , either at the University or at existing ADOT facilities
f Develop an organizational and functional structure for the facility to operate under

As noted , a final project deliverable will be to provide ADOT with a written report detailing the findings of this effort It is the strong desire of the project PI that this study will be accomplished with considerable dialog and input from key ADOT individuals so that the final recommendations truly reflect the views ,desires and capabilities of ADOT

Project 3: ADOT AC Binder Characterization Database.
1 October 1999-31 December 2000 (15 months)
$48.000

One of the keys to the successful implementation, by all state DOT agencies, of the new 2002 AASHTO Design Guide that is currently being developed under NCHRP will be to have a database of material characterizations and properties of all typical materials used within the state The specific goal of this project relates to the development of Superpave-AASHTO properties of the typical AC binders that are commonly used in ADOT construction The characterization of the AC binder properties will serve as direct required input to estimate the overall Master Curve (Complex Modulus – reduced time) of the specific asphalt mixture used in the pavement design process

The main binder properties to be evaluated for each binder tested will consist of the more conventional viscosity parameters at a range of temperatures. Penetration and Ring and Ball Softening Point results; a full range of DSR generated complex shear moduli (G^*) and phase angle (δ) for a variety of angular frequencies; BBR and Direct Tension test results

involve 9 major binder types, evaluated over the 18 month project duration These tests will also be conducted over a range of aging conditions to simulate conditions from original (refinery) to short term aging to long term field aging conditions ADOT binder data will be pooled with the ever increasing binder database that is being developed on the Superpave Models study and that will serve as initial default binder properties for the 2002 Design Guide approach.

The database will also be used to expand the predictive accuracy of models used to predict G*, phase angle (δ), and the ASTM Ai-VTSi binder consistency-temperature relationships. All of these binder properties will be directly used in the methodology that is proposed in the 2002 Design Guide Thus, by initiating work immediately on this topic, ADOT can probably reduce the required state DOT Design Guide implementation schedule by a year or more compared to other DOT agencies This developing database of the new Design Guide binder parameters will allow for the development of a historical database of typical properties that, over time, will eliminate the need to test all binders for input into the overall design guide solution

The final report deliverable will be a database summary and analysis of the typical AC binder properties, for the most commonly used ADOT binders, in Arizona This summary database will provide those key binder properties necessary for implementation of the 2002 Design Guide

Project 4: ADOT AC Mixture Stiffness Characterization Database
1 July 1999-30 June 2001 (24 months)
$78,000

The goal of this project is identical to the ultimate objective presented for Project 3, dealing with the development of a database of typical properties that will be required to implement the pavement design and analysis of the 2002 AASHTO Guide The main effort in this project will be to focus upon the development of mixture stiffness (moduli relationships) for the most commonly used ADOT asphalt mixtures

This project study will focus on the establishment of typical Master Curves of E* and tr (reduced time) that will allow the development of a mix Modulus to be expressed as a function of any load time and temperature condition These relationships will be established for 12 of the most commonly used AC Mixtures in Arizona

Mixture modulus will be evaluated in the laboratory using the E* (complex modulus test) that has been selected as the main mixture characterization for the 2002 Design Guide These tests are conducted in replicate , by a full factorial of temperatures (0,40,70,100 and 130 deg F) and frequencies (0 1, 1,10,16 and 25 Hz) In addition, dynamic modulus measurements, as determined from pulse wave velocity testing, as well as Master Curves predicted by the Witczak et al and Shell Oil equations will be used

The final product of this effort will yield a database of the 2002 AASHTO Design Guide AC Mixture properties required as direct input into the Guide analysis methodology The completion of this study will greatly expedite, and simplify, implementation by ADOT of the final Design Guide procedure

Project 5: ADOT AC Mixture Permanent Deformation Characterization Database.
1 January 2000-31 December 2001 (24 months)
$80,000

The immediate goal of this project will be to establish typical default permanent deformation parameters, consistent with the constitutive models recommended for rut depth prediction within the 2002 AASHTO Design Guide These parameters will be developed on the same 12 AC mixtures that are selected in Project 4 (characterizing the AC Mixture Stiffness)

For each mixture analyzed, three major categories of tests will be conducted at two temperature levels (100 and 130 deg F) The major categories of tests will be

a Triaxial Strength tests (c-ϕ)
b Static Creep Compliance testing until Tertiary Flow to establish Flow Time
c Repeated load Permanent deformation Testing ($\varepsilon p/\varepsilon r$ -N)

This study will eventually lead to the development of 2002 Design Guide "typical AC Mixture" parameters for direct use and implementation into the pavement performance models and predictive system used in the design and analysis procedure

Project 6: ADOT AC Fracture Characterization Database.
1 July 2000-31 December 2001 (18 months)
$75,000

The ultimate objective of this project will be to develop a Characterization database of the typical ADOT AC Mixture fracture (fatigue) properties and parameters for use with the implementation of the 2002 AASHTP Design Guide system As such, this project parallels the other materials characterization studies that are developed in the overall research plan

All fracture testing will be done at three distinct temperature levels (eg 40, 70 and 100 deg F) Testing will be accomplished through the use of indirect fracture to establish the tensile (Indirect) Strength, Fracture Energy and Crack Propagation parameters used in Fracture Mechanics applications (A and n values) In addition, indirect fatigue tests will be accomplished to generate typical tensile strain-repetition curves for each material tested

Because fatigue testing is time consuming, only six of the 12 mixtures selected for testing in the stiffness (Project 4) and Permanent Deformation (Project 5) will be evaluated

Obviously the 6 mixtures evaluated should be the most typical and representative mixtures used by ADOT.

Project 7: ADOT Unbound Materials Moduli Characterization Database.
1 October 1999-30 September 2001 (24 months)
$77,000

Of equivalent importance to the overall validation of the 2002 AASHTO Design Guide will be to insure that typical material constitutive properties, such as Mr (resilient modulus) of all typical unbound base/subbase materials are available for use in the field performance model predictions The characterization of several major typical soils will also be very desirable

In this project, it is proposed that a total of 3 typical base/subbase materials and 6 typical subgrade soils be evaluated for the non-linear moduli parameters that will be used in the 2002 AASHTO Design Guide The form of the non-linear model used will be that recommended by the PI for the NCHRP 1-28A (Harmonization of the Mr Test Protocol) project

The base and subbase materials will each be evaluated at conditions of optimum moisture and 2 other moistures (above and below optimum) at modified and standard compaction This will result in 18 testing combinations to occur For the subgrade soils, each of the 6 soils will be evaluated at 5 separate combinations of moisture and density

All resilient moduli tests will be conducted by measuring both radial and vertical displacements under the dynamic pulse repetitions Data analysis will be conducted not only for the 1-28A (2002 Design Guide) protocol, but more advanced 6-7 parameter non-linear models currently in the literature One of the more critical goals will be to establish typical non-linear ki parameters that will be used within the 2002 Design Guide Another equally critical research goal will be to establish what relationships, if any, can be developed between the ki parameters and soil suction (moisture) Before an analysis is completed, an extensive literature review will be conducted These relationships will be of immense importance in the overall pavement performance prediction scheme of the Design Guide This information will also interact with the information determined in Project 9, with the Integrated Climatic Model

Project 8: ADOT Unbound Materials Permanent Deformation Database.
1 October 1999-30 September 2001 (24 months)
$84,000

This project will focus upon developing the permanent deformation parameters for all of the unbound materials evaluated in Project 7 This testing will be completed at the same combinations of soil moisture-density testing used in Project 7 Thus , all unbound materials will have typical resilient moduli and permanent deformation properties placed

in the database for direct use in Projects 13 & 14 (Design Guide pavement performance predictions for ADOT conditions)

Two major categories of testing will be conducted The first set of tests will involve the determination of the triaxial strength parameters of each material-moisture-density combination used in the Mr project (Project 7) Once this is determined, repeated load permanent deformation tests will be conducted to generate the AASHTO Design Guide relationships of permanent strain to load repetitions for each test matrix Using power law models, the feasibility of relating the permanent strain intercept and power to the ratio of applied shear stress to shear strength will be pursued for all test combinations

In summary, the final product will be to collect a summary database of permanent deformation (rutting) parameters for the most typical base/subbase and subgrade soils encountered by ADOT in practice These parameters will be of direct use within the 2002 Design Guide for Arizona

Project 9: Implement ICM to ADOT Climatic Conditions.
1 October 2000-30 September 2001 (12 months)
$40,000

The present developmental plans for the 2002 AASHTO Design Guide call for the use of regional climatic data files, for each state agency, to be used as input into the 2002 software that will be developed for the Design Guide While the specified data input format for the needed climatic analysis is unknown at the present time (this aspect will not be finalized by the 2002 research team until 6-7 months from the current timeframe), it is fully certain that the most recent ICM (Integrated Climatic Model), developed by the FHWA (Dr Barry Dempsey) will be the basic climatic model used in the 2002 system framework

The ICM model is the most advanced real-time environmental predictive system in the world today The methodology is capable of predicting the real time (future) temperature distribution within a layered pavement system (both AC materials as well as unbound materials) at any, time and depth, for a given climatic regime Thus, AC temperatures (in as small of increments of an hour) can be predicted for subsequent use in the prediction of thermal fracture distress , permanent deformation and load associated fatigue fracture Additionally, the capability of the system to predict subsurface temperatures , that may delineate frost areas (acknowledged to have only a small probability of occurrence to exist in some mountainous areas of the state) will also be one important input in delineating seasonal areas for the annual cumulative damage approach that is being used in the 2002 Design Guide

Of critical importance to delineating seasonal moduli input data for the pavement performance prediction system in the Design Guide, is the ability of the ICM to predict the vertical soil suction (moisture) gradient, in real time, throughout the pavement structure at any time within the future This will allow for the seasonal predictions of

base/subbase/subgrade moduli, provided that the relationships between the non-linear ki parameters and soil moisture are developed from Project 7 (and also Project 8)

The main objective of this project will be to utilize the ICM to specifically develop the necessary environmental data files that will be used as input into the 2002 Design Guide In order to accomplish this, it is expected that the ICM software will be obtained and that ASU-ADOT personnel will become thoroughly familiar with its use, required input and predictive output capabilities. Typical default input values for Arizona conditions will need to be established to simplify the use of the model. Once operational familiarity with the model is attained, studies to define the true climatic zones in Arizona will be developed (this will be done separately for each distress type) Finally, once the typical Arizona climatic zones have been developed, the final climatic data input files needed for input into the 2002 Design Guide, will be developed

Project 10: Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions.
1 July 1999-30 September 2000 (15 months)
$75,000

The 2002 Design Guide will have a marked departure from the way mixed traffic loadings have historically been treated in pavement design since the inception of the AASHTO pavement design procedure nearly 40 years ago In the new proposed 2002 Design Guide. the axle load spectra distribution (by axle load and type) will be used in the cumulative pavement damage procedure developed Thus. load associated pavement damage will be incrementally determined for each axle load for each separate distress type analyzed

To facilitate the use of the new Design Guide relative to the Traffic input. a hierarchical approach to developing the inputs for the new and rehabilitation pavement design process will be created in the Design Guide This hierarchical approach will be based upon

Level 1 Site Specific Vehicle Classification and Axle Weight Data
Level 2 Site Specific Vehicle Classification Data/Regional Axle Weight Data
Level 3a. Site Specific Vehicle Classification Data/No Axle Weight Data
Level 3b. Sit Spacific Vehicle Count Data. AADT
Level 4. Special Case Studies: User Defined Gear Loads and Axle Configurations

This approach will require the collection and synthesis of five types of traffic input It is emphasized that all of this information is already available from State DOT W-4 and W-2 traffic summary tables The required traffic input data will be related to.

Normalized Axle Load Distribution or Spectrum
Normalized Vehicle Class Distribution or Spectrum
Vehicle Counts
Loading Details of the Axle Load and Axle Configuration

Traffic Factors (Directional effect, lane distribution, growth etc)

With this background, the main objective of this research project will be to analyze and develop the appropriate traffic level factors that will be appropriate to ADOT conditions and to specifically recommend the direct methodology for the traffic input for the 2002 Design Guide The prime focus of this effort should be to develop traffic input for direct implementation of the Design Guide as soon as practical

Project 11: ADOT Implementation of Simple Performance AC Mixture Test
1 April 2000-30 September 2001 (18 months)
$102,000

One of the most important undertakings of the current NCHRP Superpave Models effort that will be taking place at ASU in the future is the pursuit of a "Simple Performance Test" for AC Mixture rutting and fracture This test is intended to complement the existing Superpave Gyratory Mix Design process that is being used throughout the US This design process is solely based at the present time, upon mix volumetrics and currently lacks some type of direct physical mix response to the design process The addition of a "Simple Performance Test" is clearly intended to achieve a higher degree of reliability to the overall mix design process

At present, the Models team is evaluating 15 different candidate procedures for the Simple Performance Test and should have their best recommendation for the candidate procedure for rutting and fracture by the end of 1999 Once the test procedure is recommended, test protocols developed and system methodology guidelines for its implementation developed, the entire system will have to undergo a series of detailed field evaluations by state DOT agencies, as well as the private construction sector

The main goal of this research project will be to conduct a field evaluation of the recommended approach The approach recommended will be to utilize both ADOT and state Contractors to critically evaluate the tests relative to both their mix design potential and their usefulness as a project QA/QC tool The final report will provide an overall assessment of the utility of the recommended tests and a constructive critique as to how the overall system implementation can be improved prior to final US implementation

Project 12: Development of Rational AC Mixture Design Volumetric Window
1 October 2001-30 September 2002 (12 months)
$75,000

AC mix designs and construction specification control have historically relied upon the selection of empirically developed gravimetric and volumetric limits applied to the mix type in question For example, it is not uncommon to specify design range limits for asphalt content, air voids, voids filled with bitumen and voids in the mineral aggregate. When these criteria are applied collectively to a particular mix design in the space (plot) of Va% (y-axis) and Vb% (x-axis), a mix design "window" results This "window" of

Va-Vb , defined by all specifications , leaves an empirically developed area of all Va-Vb combinations that supposedly will result in a satisfactory mix design

In retrospect, the PI is of the opinion that the development of rationally based specifications, established from mechanistic evaluation of individual distress modes, will result in Va-Vb borders that will define volumetric specifications in a totally rational manner for a given mix Thus, if 3-D plots, using iso-contours of rational performance predictors relating to such parameters as . Fatigue repetitions, rut depth, tertiary failure, moisture damage, raveling etc are superimposed on the Va-Vb plot, a more rational and mechanistic set of mix design and performance specifications will result for a given mixture used in a particular pavement structure, in a specific environmental regime and subjected to a specified design traffic level

The main objective of this research project is tied specifically to the long term goal of developing a rational mix design process, based upon fundamental (rational or mechanistic principles) that will eventually integrate the influence of pavement structure and material properties into the performance predictions of Projects 13 & 14 This, in turn, will lead to the establishment of true "Performance Related Specifications" that will be developed in Project 15 The research project is intended to conduct an initial feasibility study of the approach presented

This study will be conducted by using one AC mixture type The mix selected should obviously be the most widely used by ADOT For this mix type, a factorial set of tests will be conducted at a matrix combination of 3 air void levels (eg 2%,5% and 8%) and at 3 AC contents (optimum and +/-1 2%) For each Va-Vb combination, fatigue, rutting, tertiary flow, moisture susceptibility and some form of raveling test will be conducted These results will be presented in the form of 3-D plots of the measured response variable, as a function of the Va-Vb location Critical values of each distress parameter will then be evaluated to the Va-Vb "Window" generated from historical mix design specifications A comparison of the "Windows" generated by both processes will be developed and a conclusion regarding the feasibility of the new approach will be made

Project 13, ADOT Pavement Prediction for AASHTO 2002 Design Guide
1 October 2001-30 June 2003 (21 months)
$250,000

It is expected that the final recommended pavement performance system for the 2002 Design Guide will be fully developed by the end of 2000-beginning of 2001 In addition nearly all of the projects noted up to this point have been aimed at collecting all of the necessary typical material , traffic and environmental input that will be required for ADOT to conduct an initial statewide evaluation of the accuracy and feasibility of the newly proposed design guide

This project will allow ADOT to become a true leader in the country relative to assessing the usefulness of the new mechanistically based pavement design and analysis tool Because all of the required input will already be available for direct use in the design guide, ADOT will be able to "fast-track" the evaluation process by several years . compared to almost all other state DOT's

It is speculated (at this point) that approximately 20-30 field sections will be required to use the 2002 AASHTO Design Guide for the comparison of the pavement performance behavior to the "real world behavior". It will be important that all of the sections selected for the comparison project have accurate field performance (distress) data, traffic and materials of construction that are included in the ADOT historic databases that are to be developed in the projects noted In fact, it is recommended and highly desirable that the listing of potential candidate sections to be used for this project be selected in the Project 1 detailed planning effort. This will allow for the other projects dealing with traffic. climate and , most importantly, materials of construction to be selected from these sections for use in all of the other appropriate projects This will greatly reduce the added amount of information that will be needed in this project and also allow for the most efficient utilization of time , personnel and financial considerations

The final project goal and deliverable will deal with the overall assessment of the utility of the newly proposed 2002 Design Guide In addition, specific areas where poor predictions are present in the Guide, as well as specific recommendations as to how the accuracy of the Guide can be enhanced for local ADOT conditions, will be presented

Project 14. Calibration of AASHTO Pavement Design and Analysis Procedures to ADOT Conditions.
1 July 2002-31 December 2003 (18 months)
$204.000

Project 13 will allow for a detailed evaluation of the performance prediction models in the initial 2002 Design Guide to actual field pavement performance of real ADOT pavement sections It is anticipated that the results of Project 13 will require that a field calibration must be conducted to insure that the 2002 AASHTO Design Guide will truly be calibrated to specific ADOT conditions

The 2002 Design Guide will be developed with necessary user input modules to make this field calibration as simple as practical for each state DOT agency Thus the major goal of this project will focus on conducting all "local calibrations" to the Design Guide so that it is applicable and accurate for ADOT and Arizona conditions

Project 15. Development of Performance Related Specifications for ADOT Flexible Pavements.
1 January 2003-30 June 2004 (18 months)
$250.000

Once Project 14 is completed, the final pavement performance prediction models, based upon mechanistic principles, will be available for the design and analysis of new and rehabilitated pavement systems. Once this system is fully acceptable to the Arizona pavement community, work can commence on the development of the most rational set of "Performance Related Specifications" that can hope to be achieved in practice. The development of such a rational goal will , without question, lead to the most realistic set of design and construction guidelines and controls that are possible. This will lead to great enhancements in the overall, long term performance of the ADOT pavement network.

The ultimate goal of this effort will be to develop a detailed set of PRS specifications that are based upon the predictions generated by the ADOT field calibrated 2002 Design Guide. This set of Asphalt related guidelines will be developed and field evaluated prior to final adoption by ADOT. It is hoped that this effort can draw upon the expertise of not only the ADOT community, but extend in a cooperative manner to the Arizona construction industry as well.

Appendix B

Provisional Research Program
Work Performance Schedule

Figure 1: Quarterly Research Budget Estimate by Project & Year

	1999		Year 1 2000			
	Jul- Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul- Sep	Oct-Dec
Major Research Project	Q3	Q4	Q1	Q2	Q3	Q4
Research Planning						
1. Develop Long Range Pavement Research Plan for ASU-ADOT	$ 25					
2. Develop Joint ASU-ADOT Superpave Lab Plan	$ 10	$ 5				
AC Materials Characterization						
3. ADOT AC Binder Characterization-Database		$ 10	$ 10	$ 10	$ 10	$ 8
4. ADOT AC Mixture Stiffness Characterization Database	$ 10	$ 10	$ 13	$ 13	$ 10	$ 10
5. ADOT AC Mixture Permanent Deformation Characterization Database			$ 15	$ 15	$ 10	$ 10
6. ADOT AC Fracture Characterization Database					$ 5	$ 10
Unbound Materials Characterization						
7. ADOT Unbound Materials Moduli Characterization Database		$ 10	$ 12	$ 13	$ 10	$ 10
8. ADOT Unbound Materials Permanent Deformation Characterization Database		$ 10	$ 12	$ 13	$ 15	$ 12
Climatic Analysis						
9. Implement ICM to ADOT Climatic Conditions						$ 5
Traffic Analysis						
10. Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions	$ 20	$ 20	$ 15	$ 15	$ 5	
AC Mixture Design						
11. ADOT Implementation to Simple Performance AC Mixture Test				$ 20	$ 20	$ 21
12. Development of Rational AC Mixture Design Volumetric Window						
Performance Prediction Models						
13. ADOT Pavement Prediction for AASHTO 2002 Design Guide						
14. Calibration of AASHTO Pavement Design and Analysis Procedure to Arizona Conditions						
Performance Related Specifications						
15. Development of Performance Related Specifications for ADOT Flexible Pavements						
Quarterly Budget Totals:	$ 65	$ 65	$ 77	$ 99	$ 85	$ 86
Annual Totals:				$ 306		

Figure 1: Quarterly Research Budget Estimate by Project

	Year 2 2001				Year 3 2002			
	Jan-Mar	Apr-Jun	Jul- Sep	Oct-Dec	Jan-Mar	Apr-Jun	Jul- Sep	Oct-Dec
Major Research Project	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Research Planning								
1. Develop Long Range Pavement Research Plan for ASU-ADOT								
2. Develop Joint ASU-ADOT Superpave Lab Plan								
AC Materials Characterization								
3. ADOT AC Binder Characterization-Database								
4. ADOT AC Mixture Stiffness Characterization Database	$ 7	$ 5						
5. ADOT AC Mixture Permanent Deformation Characterization Database	$ 10	$ 10	$ 5	$ 5				
6. ADOT AC Fracture Characterization Database	$ 10	$ 12	$ 20	$ 18				
Unbound Materials Characterization								
7. ADOT Unbound Materials Moduli Characterization Database	$ 10	$ 6	$ 6					
8. ADOT Unbound Materials Permanent Deformation Characterization Database	$ 10	$ 6	$ 6					
Climatic Analysis								
9. Implement ICM to ADOT Climatic Conditions	$ 10	$ 12	$ 13					
Traffic Analysis								
10. Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions								
AC Mixture Design								
11. ADOT Implementation to Simple Performance AC Mixture Test	$ 16	$ 12	$ 13					
12. Development of Rational AC Mixture Design Volumetric Window				$ 28	$ 25	$ 15	$ 7	
Performance Prediction Models								
13. ADOT Pavement Prediction for AASHTO 2002 Design Guide				$ 40	$ 42	$ 45	$ 40	$ 35
14. Calibration of AASHTO Pavement Design and Analysis Procedure to Arizona Conditions							$ 30	$ 35
Performance Related Specifications								
15. Development of Performance Related Specifications for ADOT Flexible Pavements								
Quarterly Budget Totals:	$ 73	$ 63	$ 63	$ 91	$ 67	$ 60	$ 77	$ 70
Annual Totals:		$ 307				$ 281		

Figure 1: Quarterly Research Budget Estimate by Project

	Year 4 2003				Year 5 2004		
	Jan-Mar	Apr-Jun	Jul- Sep	Oct-Dec	Jan-Mar	Apr-Jun	
Major Research Project	Q1	Q2	Q3	Q4	Q1	Q2	Project Totals:
Research Planning							
1. Develop Long Range Pavement Research Plan for ASU-ADOT							$ 25
2. Develop Joint ASU-ADOT Superpave Lab Plan							$ 15
AC Materials Characterization							
3. ADOT AC Binder Characterization-Database							$ 48
4. ADOT AC Mixture Stiffness Characterization Database							$ 78
5. ADOT AC Mixture Permanent Deformation Characterization Database							$ 80
6. ADOT AC Fracture Characterization Database							$ 75
Unbound Materials Characterization							
7. ADOT Unbound Materials Moduli Characterization Database							$ 77
8. ADOT Unbound Materials Permanent Deformation Characterization Database							$ 84
Climatic Analysis							
9. Implement ICM to ADOT Climatic Conditions							$ 40
Traffic Analysis							
10. Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions							$ 75
AC Mixture Design							
11. ADOT Implementation to Simple Performance AC Mixture Test							$ 102
12. Development of Rational AC Mixture Design Volumetric Window							$ 75
Performance Prediction Models							
13. ADOT Pavement Prediction for AASHTO 2002 Design Guide	$ 25	$ 23					$ 250
14. Calibration of AASHTO Pavement Design and Analysis Procedure to Arizona Conditions	$ 38	$ 36	$ 35	$ 30			$ 204
Performance Related Specifications							
15. Development of Performance Related Specifications for ADOT Flexible Pavements	$ 20	$ 25	$ 45	$ 50	$ 60	$ 50	$ 250
Quarterly Budget Totals:	$ 83	$ 84	$ 80	$ 80	$ 60	$ 50	$ 1,478
Annual Totals:		$ 314				$ 270	$ 1,478

Appendix C

Provisional Annual Budget Breakdown
By Specific Research Project

ADOT-ASU Joint Research Program

Table 1: Preliminary Time -Work Activity Breakdown by Agency

Version: V6 0
Date Prepared 13-Jun-99
Prepared by: MWW
Anticipated Start Date: 1-Jul-99

Year 1

		M Wilczak	M Mamlouk	Emmanuel	Zhu	W Houston	K Walsh	K Kaloush	T.Pellinen	C.Zapata	W.Mirza	D.Andrei
1 Develop Long Range Pavement Research Plan	******	144				32		80	80		144	
2 Develop Joint ASU-ADOT Superpave Lab Plan	******	100							24		80	
3 ADOT AC Binder Characterization	******	20			48				56		64	
4 ADOT AC Mixture Stiffness Characterization	******	16			64				160		64	
5 ADOT AC Mixture Permanent Deformation	******	16			64			160			64	
6 ADOT AC Fracture Characterization												
7 ADOT Unbound Materials Moduli Characterization	******	40				120						280
8 ADOT Unbound Materials Permanent Deformation Characterization Database	******	40				40	200			320		
9 Implement ICM to ADOT Climatic Conditions												
10 Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions	******	40									200	
11 ADOT Implementation of Simple Performance Test	******	16						64	64		64	
12 Development of Rational AC Mix Design Volumetric Window												
13 ADOT Pavement Prediction for AASHTO 2002 Design Guide												
14 Calibration of AASHTO Pavement Design and Analysis Procedures to Arizona Conditions												
15 Development of Performance Related Specifications for ADOT Flexible Pavements												
Totals		432	0	0	176	192	200	304	384	320	680	280
Total Work Year 1(12 mo-2080 hrs)	2080	20 8%	0 0%	0 0%	8 5%	9 2%	9 6%	14 6%	18.5%	15.4%	32 7%	21.5%
(12 mo-GRA Full Time:1300 hrs)												

Base Salary		$112,000	$91,528	$60,665	$58,665	$101,285	$57,330	$43,000	$40,000	$50,000	$65,000	$30,000
per Period		per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 12 mo	per 12 mo	per 12 mo	per 12 mo	per 12 mo
No of Hours		1560	1560	1560	1560	1560	1560	2080	2080	2080	2080	1300
Salary($/hr)		$ 71 79	$ 58 67	$ 38 89	$ 37 61	$ 64 93	$ 36 75	$ 20 67	$ 19 23	$ 24 04	$ 31 25	$ 23 08
Benefit %		25 0%	25 0%	25 0%	25 0%	25 0%	25 0%	30.0%	30.0%	30.0%	30 0%	30.0%
Benefit ($/hr)		$ 17 95	$ 14 67	$ 9 72	$ 9 40	$ 16 23	$ 9 19	$ 6 20	$ 5 77	$ 7 21	$ 9 38	$ 6 92
Tuition ($)												
Total Salary		$ 31,015	$	$	$ 6,619	$ 12,466	$ 7,350	$ 6,285	$ 7,385	$ 7,692	$ 21,250	$ 6,462
Total Ben		$ 7,754	$	$	$ 1,655	$ 3,116	$ 1,838	$ 1,885	$ 2,215	$ 2,308	$ 6,375	$ 1,938

Total Salary and Benefits:	$ 195,653
Travel:	$ 2,500
Operating Expenses:	$ 2,500
Subtotal:	$ 200,653
ASU Overhead (52.5%):	$ 105,343
Yearly Total	$ 305,996

El-Basyouny	GRA-2	GRA-3	Part time	Proj Admin	ASU Total
				80	560
			80	64	348
	240		120	100	648
	480		80	100	964
	200		120	80	704
					0
			100	64	604
			80	64	744
					0
		1000	40	64	1344
			280	40	528
					0
					0
					0
					0
0	920	1000	900	656	6444
0 0%	70 8%	76 9%	43 3%	31 5%	

$25,000 per 12 mo 1300	$20,000 per 12 mo 1300	$20,000 per 12 mo 1300	$12 00 per hr 1	$25,400 per 12 mo 2080		
$ 19 23	$ 15 38	$ 15 38	$ 12 00	$ 12 21		
30 0%	30 0%	30 0%	4 0%	30 0%		
$ 5 77	$ 4 62	$ 4 62	$ 0 48	$ 3 66		
$	$ 14,154	$ 15,385	$ 10,800	$ 8,011	$	154,872
$	$ 4,246	$ 4,615	$ 432	$ 2,403	$	40,781

ADOT-ASU Joint Research Program

Table 1 Preliminary Time-Work Activity Breakdown by Agency

Version: V6.0
Date Prepared: 13-Jun-99
Prepared by: MWW
Anticipated Start Date: 1-Jul-99

Year 2

		M Witczak	M Mamlouk	Emmanuel	Zhu	W Houston	K Walsh	K Kaloush	T Pellinen	C Zapala	W Mirza
1 Develop Long Range Pavement Research Plan											
2 Develop Joint ASU-ADOT Superpave Lab Plan											
3 ADOT AC Binder Characterization	******	24							48		48
4 ADOT AC Mixture Stiffness Characterization	******	48			60				80		64
5 ADOT AC Mixture Permanent Deformation	******	64			64			180			64
6 ADOT AC Fracture Characterization	******	48			120						80
7 ADOT Unbound Materials Moduli Characterization	******	48				144					
8 ADOT Unbound Materials Permanent Deformation Characterization Database	******	48					200			240	
9 Implement ICM to ADOT Climatic Conditions	******	48				64	120			160	64
10 Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions	******	16									100
11 ADOT Implementation of Simple Performance Test	******	48						280	280		100
12 Development of Rational AC Mix Design Volumetric Window											
13 ADOT Pavement Prediction for AASHTO 2002 Design Guide											
14 Calibration of AASHTO Pavement Design and Analysis Procedures to Arizona Conditions											
15 Development of Performance Related Specifications for ADOT Flexible Pavements											
Totals:		392	0	0	244	208	320	460	408	400	520
Total Work Year 1(12 mo-2080 hrs)	2080	18.8%	0.0%	0.0%	11.7%	10.0%	15.4%	22.1%	19.6%	19.2%	25.0%
(12 mo-GRA Full Time 1300 hrs)											

Base Salary	$112,000	$91,528	$60,665	$58,665	$101,285	$57,330	$43,000	$40,000	$50,000	$65,000
per Period	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 12 mo	per 12 mo	per 12 mo	per 12 mo
No of Hours	1560	1560	1560	1560	1560	1560	2080	2080	2080	2080
Salary($/hr)	$ 71.79	$ 58.67	$ 38.89	$ 37.61	$ 64.93	$ 36.75	$ 20.67	$ 19.23	$ 24.04	$ 31.25
Benefit %	25.0%	25.0%	25.0%	25.0%	25.0%	25.0%	30.0%	30.0%	30.0%	30.0%
Benefit ($/hr)	$ 17.95	$ 14.67	$ 9.72	$ 9.40	$ 16.23	$ 9.19	$ 6.20	$ 5.77	$ 7.21	$ 9.38
Tuition ($)										
Total Salary	$ 28,144	$ -	$ -	$ 9,176	$ 13,505	$ 11,760	$ 9,510	$ 7,846	$ 9,615	$ 16,250
Total Ben	$ 7,036	$ -	$ -	$ 2,294	$ 3,376	$ 2,940	$ 2,853	$ 2,354	$ 2,885	$ 4,875

Total Salary and Benefits	$ 196,354
Travel	$ 2,500
Operating Expenses	$ 2,500
Subtotal	$ 201,354
ASU Overhead (52.5%)	$ 105,709
Yearly Total	$ 307,061

D Andrei	El-Basyouny	GRA-2	GRA-3	Part Time	Proj Admin		ASU Total
							0
							0
		140		64	80		404
		400		64	64		780
		320		80	64		836
			480	80	80		888
320				120	72		704
				120	80		688
				64	64		584
			100	24	64		304
				420	100		1228
							0
							0
							0
							0
320	0	860	580	1036	668		6416
24 6%	0 0%	66 2%	44 6%	49 8%	32 1%		

$30,000 per 12 mo 1300	$25 000 per 12 mo 1300	$20,000 per 12 mo 1300	$20,000 per 12 mo 1300	$12 00 per hr 1	$25,400 per 12 mo 2080		
$ 23 08	$ 19 23	$ 15 38	$ 15 38	$ 12 00	$ 12 21		
30 0%	30 0%	30 0%	30 0%	4 0%	30 0%		
$ 6 92	$ 5 77	$ 4 62	$ 4 62	$ 0 48	$ 3 66		
$ 7,385	$	$ 13,231	$ 8,923	$ 12,432	$ 8,157	$	155,933
$ 2,215	$	$ 3,969	$ 2,677	$ 497	$ 2,447	$	40,418

ADOT-ASU Joint Research Program

Table 1 Preliminary Time Work Activity Breakdown by Agency

Version: V6 0
Date Prepared: 13-Jun-99
Prepared by: MWW
Anticipated Start Date: 1-Jul-99

Year 3

		M Witczak	M Mamlouk	Emmanuel	Zhu	W Houston	K Walsh	K Kaloush	T Pellinen	C Zapata	W Mirza
1 Develop Long Range Pavement Research Plan											
2 Develop Joint ASU-ADOT Superpave Lab Plan											
3 ADOT AC Binder Characterization											
4 ADOT AC Mixture Stiffness Characterization	******	24			48						64
5 ADOT AC Mixture Permanent Deformation	******	32			56						48
6 ADOT AC Fracture Characterization	******	20				40					
7 ADOT Unbound Materials Moduli Characterization	******	20					64			200	
8 ADOT Unbound Materials Permanent Deformation Characterization Database	******	32				40	64			144	
9 Implement ICM to ADOT Climatic Conditions	******	48						100	100		64
10 Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions	******	56							200		64
11 ADOT Implementation of Simple Performance Test	******	120			64	64		120	120	480	120
12 Development of Rational AC Mix Design Volumetric Window											
13 ADOT Pavement Prediction for AASHTO 2002 Design Guide											
14 Calibration of AASHTO Pavement Design and Analysis Procedures to Arizona Conditions											
15 Development of Performance Related Specifications for ADOT Flexible Pavements											
Totals		352	0	0	168	144	128	220	420	824	360
Total Work Year 1(12 mo-2080 hrs) (12 mo-GRA Full Time 1300 hrs)	2080	16 9%	0 0%	0 0%	8 1%	6 9%	6 2%	10 6%	20 2%	39 6%	17 3%

Base Salary	$112,000	$91,528	$60,665	$58,665	$101,285	$57,330	$43,000	$40,000	$50,000	$65,000
per Period	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 9 mo	per 12 mo	per 12 mo	per 12 mo	per 12 mo
No of Hours	1560	1560	1560	1560	1560	1560	2080	2080	2080	2080
Salary($/hr)	$ 71 79	$ 58 67	$ 38 89	$ 37 61	$ 64 93	$ 36 75	$ 20 67	$ 19 23	$ 24 04	$ 31 25
Benefit %	25 0%	25 0%	25 0%	25 0%	25 0%	25 0%	30 0%	30 0%	30 0%	30 0%
Benefit ($/hr)	$ 17 95	$ 14 67	$ 9 72	$ 9 40	$ 16 23	$ 9 19	$ 6 20	$ 5 77	$ 7 21	$ 9 38
Tuition ($)										
Total Salary	$ 25,272	$	$	$ 6,318	$ 9,349	$ 4,704	$ 4,548	$ 8,077	$ 19,808	$ 11,250
Total Ben	$ 6,318	$	$	$ 1,579	$ 2,337	$ 1,176	$ 1,364	$ 2,423	$ 5,942	$ 3,375

Total Salary and Benefits	$ 176,395
Travel:	$ 5,000
Operating Expenses	$ 3,000
Subtotal:	$ 184,395
ASU Overhead (52 5%).	$ 96,807
Yearly Total:	$ 281,202

D Andrei	El-Basyouny	GRA-2	GRA-3	Part Time	Proj Admin		ASU Total
							0
							0
							0
							0
				80	40		256
			540	80	36		792
240				80	32		412
				100	32		416
					32		312
							0
				160	48		520
			320	280	100		1020
80		650		280	280		2378
							0
							0
320	0	650	860	1060	600		6106
24 6%	0 0%	50 0%	66 2%	51 0%	28 8%		

$30,000 per 12 mo 1300	$25,000 per 12 mo 1300	$20,000 per 12 mo 1300	$20,000 per 12 mo 1300	$12 00 per hr 1	$25,400 per 12 mo 2080	
$ 23 08	$ 19 23	$ 15 38	$ 15 38	$ 12 00	$ 12 21	
30 0%	30 0%	30 0%	30 0%	4 0%	30 0%	
$ 6 92	$ 5 77	$ 4 62	$ 4 62	$ 0 48	$ 3 66	
$ 7,385	$ -	$ 10,000	$ 13,231	$ 12,720	$ 7,327	$ 139,988
$ 2,215	$ -	$ 3,000	$ 3,969	$ 509	$ 2,198	$ 36,407

ADOT-ASU Joint Research Program

Table 1 Preliminary Time Work Activity Breakdown by Agency

Version: V6 0
Date Prepared: 13-Jun-99
Prepared by: MWW
Anticipated Start Date: 1-Jul-99

Year 1

		M Witczak	M Mamlouk	Emmanuel	Zhu	W Houston	K Walsh	K Kaloush	T Pellinen	C Zapata	W Mirza	D Andrei
1 Develop Long Range Pavement Research Plan												
2 Develop Joint ASU-ADOT Superpave Lab Plan												
3 ADOT AC Binder Characterization												
4 ADOT AC Mixture Stiffness Characterization												
5 ADOT AC Mixture Permanent Deformation												
6 ADOT AC Fracture Characterization												
7 ADOT Unbound Materials Moduli Characterization												
8 ADOT Unbound Materials Permanent Deformation Characterization Database												
9 Implement ICM to ADOT Climatic Conditions												
10 Development of 2002 Design Guide Traffic Spectra Files for ADOT Conditions												
11 ADOT Implementation of Simple Performance Test												
12 Development of Rational AC Mix Design Volumetric Window	******	48							40		48	
13 ADOT Pavement Prediction for AASHTO 2002 Design Guide	******	120			60	40		180	180	420	240	80
14 Calibration of AASHTO Pavement Design and Analysis Procedures to Arizona Conditions	******	100			64	40		180	180	200	100	64
15 Development of Performance Related Specifications for ADOT Flexible Pavements	******	80			80	32	40	180	180	160	64	80
Totals		348	0	0	204	112	40	540	580	780	452	224
Total Work Year 1(12 mo-2080 hrs) (12 mo-GRA Full Time-1300 hrs)	2080	16 7%	0 0%	0 0%	9 8%	5 4%	1 9%	26 0%	27 9%	37 5%	21 7%	17 2%

Base Salary per Period	$112,000 per 9 mo	$91,528 per 9 mo	$60,665 per 9 mo	$58,665 per 9 mo	$101,285 per 9 mo	$57,330 per 9 mo	$43,000 per 12 mo	$40,000 per 12 mo	$50,000 per 12 mo	$65,000 per 12 mo	$30,000 per 12 mo
No of Hours	1560	1560	1560	1560	1560	1560	2080	2080	2080	2080	1300
Salary($/hr)	$ 71 79	$ 58 67	$ 38 89	$ 37 61	$ 64 93	$ 36 75	$ 20 67	$ 19 23	$ 24 04	$ 31 25	$ 23 08
Benefit %	25 0%	25 0%	25 0%	25 0%	25 0%	25 0%	30 0%	30 0%	30 0%	30 0%	30 0%
Benefit ($/hr)	$ 17 95	$ 14 67	$ 9 72	$ 9 40	$ 16 23	$ 9 19	$ 6 20	$ 5 77	$ 7 21	$ 9 38	$ 6 92
Tuition ($)											
Total Salary	$ 24,985	$	$	$ 7,672	$ 7,272	$ 1,470	$ 11,163	$ 11,154	$ 18,750	$ 14,125	$ 5,169
Total Ben	$ 6,246	$	$	$ 1,918	$ 1,818	$ 368	$ 3,349	$ 3,346	$ 5,625	$ 4,238	$ 1,551

Total Salary and Benefits	$ 196,274
Travel	$ 6,000
Operating Expenses	$ 3,500
Subtotal	$ 205,774
ASU Overhead (52 5%)	$ 108,031
Yearly Total	$ 313,805

El-Basyouny	GRA-2	GRA-3	Part Time	Proj Admin	ASU Total
					0
					0
					0
					0
					0
					0
					0
					0
					0
					0
		320	120	72	648
	1000		640	200	3160
		500	320	220	1968
		280	120	80	1376
0	1000	1100	1200	572	7152
0 0%	76 9%	84 6%	57 7%	27 5%	

$25,000	$20,000	$20,000	$12 00	$25,400		
per 12 mo	per 12 mo	per 12 mo	per hr	per 12 mo		
1300	1300	1300	1	2080		
$ 19 23	$ 15 38	$ 15 38	$ 12 00	$ 12 21		
30 0%	30 0%	30 0%	4 0%	30 0%		
$ 5 77	$ 4 62	$ 4 62	$ 0 48	$ 3 66		
$	$ 15,385	$ 16 923	$ 14,400	$ 6 985	$	155,452
$	$ 4,615	$ 5 077	$ 576	$ 2,096	$	40,822

El-Basyouny	GRA-2	GRA-3	Part Time	Prof Admin	ASU Total
					0
					0
					0
					0
					0
					0
					0
					0
					0
					0
					0
					0
	650		640	120	2558
-		650	400	400	3310
0	650	650	1040	520	5868
0 0%	50 0%	50 0%	50 0%	25 0%	
$25,000 per 12 mo 1300	$20,000 per 12 mo 1300	$20,000 per 12 mo 1300	$12 00 per hr 1	$25,400 per 12 mo 2080	
$ 19 23	$ 15 38	$ 15 38	$ 12 00	$ 12 21	
30 0%	30 0%	30 0%	4 0%	30 0%	
$ 5 77	$ 4 62	$ 4 62	$ 0 48	$ 3 66	
$	$ 10,000	$ 10,000	$ 12,480	$ 6 350	$ 133 897
$	$ 3,000	$ 3,000	$ 499	$ 1 905	$ 35 034